GRAND CANYON –PARASHANT NATIONAL MONUMENT
GEOLOGIC RESOURCES MANAGEMENT ISSUES
SCOPING SUMMARY

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Executive Summary

In a Geologic Resources Evaluation scoping meeting held in St. George, Utah, on April 28-29, 2003, the scoping meeting participants identified the following geologic resources management issues.

1. Caves and karst related features such as sinkholes and breccia pipes are being impacted by human activity, such as the dumping of garbage in sinkholes and the mining of breccia pipes.

2. Wind erosion and deposition of suspended dust are important to the ecosystem in that they bring in material from sources outside the monument and deposit them and rework them within the park.

3. Desert crusts are prevalent in the park and are locally impacted by foot traffic and probably ORV use.

4. Flash floods are relatively common and, where they occur, impact infrastructure, structures, and visitor safety. Flash floods can also pick up contaminants such as cattle wastes, mine tailings, and human waste.

5. There are abandoned mines that may pose visitor safety issues. Some are being preserved as cultural resources (headframes, draw works, abandoned vehicles, etc.). Uranium tailings may be a health hazard.

6. Location and identification of vertebrate fossils are a high priority. There may be illegal collecting (theft) by visitors.

7. There is active seismicity in the park, both along major faults (Hurricane, Grand Wash) and along numerous secondary faults whose locations are not well known. The park needs more seismic monitoring stations.

8. There is potential for groundwater contamination especially in high use areas. Pesticides, waste oil, trash, fertilizer, and nitrates are possible pollutants.

Introduction

The National Park Service held a Geologic Resources Evaluation scoping meeting at the Bureau of Land Management headquarters in St. George, Utah, on Monday, April 28, 2003. The purpose of the meeting was to discuss the status of geologic mapping in Parashant National Monument (NM), the associated bibliography, and the geologic issues in the park. The products to be derived from the scoping meeting are: (1) Digitized geologic maps covering the monument; (2) An updated and verified bibliography; (3) Scoping summary (this report); and (4) A Geologic Resources Evaluation Report which brings together all of these products.

The Grand Canyon-Parashant National Monument was established by presidential proclamation on January 11, 2000. It consists of over one million acres in northwestern Arizona in an area north of the Colorado River known as the Arizona Strip. Prior to establishment, most of the public land was administered by the Bureau of Land Management (BLM). At present, Parashant NM consists of the BLM land as well as part of Lake Mead National Recreation Area, administered by the National Park Service (NPS). Thus, Parashant is jointly administered by the BLM and the NPS. Monument headquarters is located in St. George, Utah.

Parashant NM is covered by three existing geologic maps at 1:100,000 scale: Littlefield, Mount Trumbull, and Peach Springs. Bedrock and surficial maps are adequate. Of the 7½' quadrangles (1:24,000), only two are missing, the Virgin Peak and the Hen Spring quads, both on the Overton sheet.

Physiography

Most of Parashant is in the Colorado Plateau physiographic province, consisting mostly of Paleozoic sediments, capped by the Triassic Moenkopi formation and Quaternary lava flows. The extreme west and northwest includes the Basin and Range and Mojave geologic provinces. Prominent topographic features are the Shivwits Plateau, Grand Wash Cliffs, and the Hurricane Cliffs. As one approaches the Grand Canyon to the south, the plateau is dissected by numerous deep canyons, including Parashant Canyon, Andrus Canyon, and Whitmore Canyon. (See attached map.)

Geology

The Shivwits Plateau, the westernmost part of the Colorado Plateau physiographic province, is physiographically and stratigraphically typical of the Grand Canyon region. The Shivwits Plateau is bounded on the east by the Hurricane Cliffs, separating it from the Uinkaret Plateau to the east. On the west, it is bounded by the Grand Wash Cliffs which forms the boundary of the Basin and Range physiographic province. To the north it extends to the St. George Basin in Utah. The Shivwits Plateau is mostly rolling dissected tableland and lava-capped buttes.

The Hurricane Cliffs and the Grand Wash Cliffs are structural features formed by the Hurricane Fault and Grand Wash faults respectively. These are high-angle, normal faults with the greatest movement along the dip face, down-thrown to the west. Both of these faults extend hundred of miles trending north-south. Displacements are on the order of thousands of feet, decreasing to the south on the Hurricane Fault and decreasing to the north on the Grand Wash fault. Movement along both these faults began in the Miocene and continued into the Pliocene on the Grand Wash fault and into the Holocene on the Hurricane fault. Other faults in the area are mostly high-angle, dip-slip with some scissor component. These trend generally north-south and produce a series of grabens. The Shivwits Plateau is underlain by Paleozoic strata dipping 2 to 5 degrees to the northeast.

The stratigraphy of Parashant NM is typical of the Grand Canyon area. Much of the Shivwits Plateau is capped by Kaibab Limestone of Upper Permian age, although in some of the canyons the strata may range in age from Precambrian to Middle Jurassic (Moenkopi) as well as Pleistocene to Holocene lavas.

The Cambrian is represented by the Tonto Group which consists of about 150 feet of Tapeats Sandstone, 400 feet of Bright Angle Shale, 670 feet of Mauv Limestone, and 221 feet of an unnamed dolostone. The Tonto Group indicates deposition in a relatively shallow transgressing sea with facies changes occurring between the formations. Rock of Ordovician and Silurian age are not found on the Shivwits Plateau.

The Devonian consists of mostly of carbonates in the Temple Butte Limestone. Deposition of the carbonates took place on an old erosion surface in sinkholes and channels. Above the Temple Butte, the Mississippian Redwall Limestone is one of the most prominent and extensive formations in northern Arizona. It is equivalent to the Leadville Limestone in Colorado. The Redwall forms shear cliffs over 600 feet high. The Redwall consists of four members. The oldest (lowest stratigraphically) is the Whitmore Wash member, named from the type area in Whitmore Wash southeast of Mt. Trumbull. It thins to the east from over 200 feet at Iceberg Canyon near the Arizona-Nevada border to 70-80 feet in the eastern Grand Canyon. McKee (1969) measured the Whitmore Wash member at 101 feet in Whitmore Wash. It consists of thick-bedded, gray, fine-grained limestone, locally grading into dolostone. It rests unconformably on the Temple Butte Limestone. The upper limit is defined by thin chert beds alternating with limestone in the overlying Thunder Springs member. The Thunder Springs member is 138 feet thick at the type area on the Thunder River Trail.

The overlying Mooney Falls member is the most consistent cliff-former of the Redwall. It is composed of mostly light olive-gray, coarse-grained limestone with crinoid joints. An upper thin chert layer is white, thin-bedded, alternating with thin-bedded limestone. It pinches out laterally from a maximum of 3 feet thick. The uppermost member is the Horseshoe Mesa member, consisting of gray, fine-grained, thick-bedded limestone. The lower half forms a massive cliff and the upper half weathers to receding step-like ledges at the top of Parashant Canyon.

Above the Redwall Limestone is the Supai Group of Pennsylvanian-Permian age. The Supai consists of four formations: Watahomigi, Manakacha, Wescogame, and the Esplanade Sandstone. These formations consist of beds of red siltstone, red sandstone, limestones, and conglomerates. The Hermit Shale overlies the Supai Group and intertongues with the underlying Esplanade Sandstone in some areas. The Supai Group consists of soft gypsiferous (in the lower 100+ feet), red sandstones, siltstones, and mudstones.

Above the Hermit Shale lies about 40 feet of Permian Coconino Sandstone overlain by over 300 feet of the Permian Toroweap Formation. The Toroweap consists of a lower sequence of dolostones, gypsum, and red clastics, a middle sequence of cliff-forming limestones, and an upper evaporite, clastic, and carbonate sequence grading into the overlying Permian Kaibab Formation. The Kaibab consists of approximately 400 feet of cliff-forming, cherty limestone and an upper sequence of limestones, evaporites, and clastics. Most of the Shivwits Plateau is capped by the Kaibab Limestone. There are outcroppings of Lower Triassic strata represented by the Moenkopi Formation. Above the Moenkopi are Quaternary basaltic lava flows.

Significant Geologic Resource Management Issues in Parashant NM

1. Cave and Karst Issues

Much of the karst activity in Parashant is in the Redwall Limestone and/or in the Kaibab limestone. Surface reflection of this is are sinkholes, caves and breccia pipes. Much of the geologic controls on groundwater are karst and fault related. There is no single aquifer, but numerous fault-bound aquifers of varying sizes and depths. Springs that occur in the monument are mostly fault related. Springs appear to be drying up, but there has been no systematic study. Since being declared a monument, visitation has increased and is expected to increase, creating additional impacts. Sinkholes are often used a trash dumps. Breccia pipes have, in the recent past, been mined for uranium, copper, and gold. Although reclaimed, most of the pipes have been mined out and no longer exist. Breccia pipes have plants unique to them such as the Grand Canyon rose.

Primary questions that should be addressed are: (1) Are caves and karst features being degraded and if so, what are the causes? (2) What is the natural rate of recovery of these features? (3) What can be done to promote recovery? (4) What impact does air quality have on the cave and karst systems?

2. Wind Erosion and Dust Deposition

Dust storms and the deposition of wind-blown material has a great impact on Parashant ecology. The monument is, for the most part, a recipient of dust rather than a donor. Dust and pollutants from as far away as the California coast are deposited in the monument. There are some small dune fields but no of great significance. Questions include: (1) What impact does wind-blown material have on the ecology of the park, both types of impacts and amount of impact? (2) What are the constituents of this material and are there any toxic or potential hazardous substances being blown in?

3. Desert Crusts (Rare Substrates)

Desert crusts are prevalent in Parashant. They are delicate systems combining physical, chemical, and biological features. They are easily degraded or destroyed by trampling, by both animals and humans. A history of cattle grazing in the monument and the present increasing visitor use have led to possible widespread destruction these crusts. In some areas, an increase in ATV use has lead to the destruction of desert crust, leaving ruts and tire tracks that will remain for many years to come. A survey of areas that support these crusts should be conducted followed by monitoring and research. Other soils issues will be addressed at a later time. Question are: (1) What are the impacts of ATV use on desert crusts and where are the major occurrences of ATV activity? (2) Can these degraded soils be recovered and if so how, and how long will recovery take? (3) How can continuing impacts from ATVs be mitigated? (4) Should an ATV (or all vehicular activity) management plan be developed?

4. Surface Water

Flash floods are not uncommon in this semiarid area. Floods have short-term but significant impacts on roads, power lines, gas lines and other infrastructure. Occasionally roads must be cleared of rocks and other debris. There are issues with surface transport of contaminants such as runoff carrying livestock fecal matter and human contaminants from increasing human activity and visitor use. Questions: (1) Have the areas of flash flooding been identified and mapped? (2) Are there alternatives to the placement of certain roads and facilities – can they be moved out of harms way? (3) If not, are there feasible methods for mitigating the impact of flash flooding?

5. Abandoned Mines

There are over one hundred abandoned mines in the Lake Mead portion of Parashant alone. Many of these are in breccia pipes and were mined for uranium, gold and copper. If uranium was the principal commodity it is very likely that there are radioactive tailings in the vicinity. Depending on the concentration of uranium and other radioactive elements in the tailings, these could be hazardous, depending on the length of exposure. Wind will pick up the tailings particles and distribute them over a wide area. No acid mine drainage was mentioned by Parashant staff, although any ore or tailings containing sulfides can produce acid.

Many of these abandoned mines are also safety problems from the stand point of open shafts, adits, winzes, raises, partially collapsed workings, and bad air. There is always the possibility of injury or death from visitors exploring these mines. Some mines still have old headframes, sheaves, ladders, wire rope, and other mining related equipment that are in extreme disrepair and could be dangerous. Some of this material could be preserved and interpreted; much could be dumped back into the mine opening and covered.

6. Paleontological (Fossil) Resources

Some research has been done on pack rat middens by Jim Mead at Northern Arizona University, but much of the paleontology of the Parashant area is not well known. The proclamation declaring Parashant a national monument identifies the need to preserve the significant Paleozoic invertebrates. Among these are bryozoans and brachiopods in the Calville Limestone of the Grand Wash Cliffs, and brachiopods, pelecypods, fenestrate bryozoa, and crinoid ossicles in the Toroweap and Kaibab formations of Whitmore Canyon. There are also sponges in nodules and pectenoid pelecypods throughout the Kaibab Formation of Parashant Canyon.

The identification of Pleistocene and Holocene vertebrates is of high importance, but much of the unit remains relatively unknown. There is evidence that vertebrate fossils are being removed by pot hunters searching for archeological artifacts, but how much of this activity is occurring is not known. A first step is a comprehensive inventory of the fossil resources followed by the establishment of a monitoring program. The Parashant area is large and although the geology is known, paleo-resources remain virtually unknown. What is the condition of paleontological resources in Parashant? Are they being lost through human activity (theft, vandalism)? Are these resources scientifically significant?

7. Seismicity

In addition to the Hurricane and Grand Wash faults, there are numerous high-angle, normal faults, mostly trending in a north-south direction. There is a need to determine the number and magnitude of seismic events for health and safety reasons, as well as to determine where any new construction should be placed. There is a need for more seismic monitoring. How many seismic stations would provide adequate coverage, and where should these stations be sited?

8. Groundwater

There is potential for groundwater contamination from human related activities. Livestock wastes, pesticides, fertilizer, nitrates, waste oil and trash all have impacts on groundwater quality. What is the overall quality of the groundwater? Is there adequate monitoring for both water quality and quantity?

9. Hazards

Potential hazards include slope failure either induced by seismic activity, by precipitation (see Surface Water, above), or by human activity, such as leaving unnaturally steepened slopes in construction areas. There are potential impacts on infrastructure such as road, pipelines, and power lines. Rock falls are not uncommon and can severely impact infrastructure and threaten human life. Where are the hazard-prone areas? Do these hazards potentially subject visitors and park staff to harm?

10. Volcanic Features

In Parashant volcanic features include lava flows, cinder cones, pyroclastic deposits, lava falls, lava tubes and rafted lava, solidified lava transported by subsequent flows. Volcanic activity has occurred as recently as about 1000 years ago as evidenced by pottery chards in basalt flows. There has been mining of the cinder cones in the past but there is no active cinder production today. There is very little geothermal activity. The water in Pakoon Springs is at about 80ºF+. The spring is occasionally used by visitors. There is an occurrence of columnar basalt in Whitmore Canyon.

Scoping Meeting Participants

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Bonnie Murchey	Geologist	USGS
Kyle Voyles	Physical Scientist	NPS, Parashant NM

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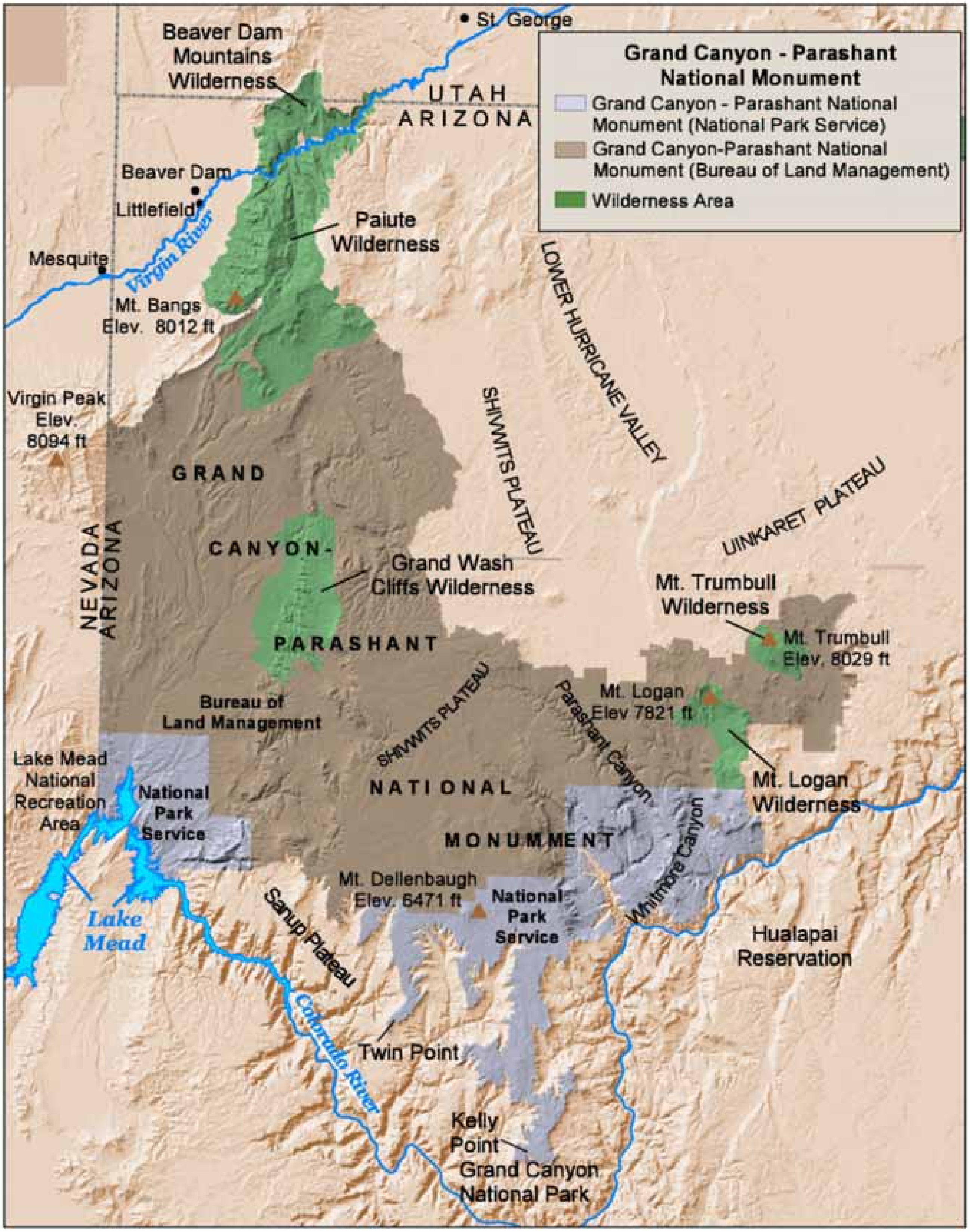

Grand Canyon - Parashant National Monument
Grand Canyon - Parashant National Monument (National Park Service)
Grand Canyon-Parashant National Monument (Bureau of Land Management)
Wilderness Area
St. George
UTAH
ARIZONA
NEVADA
ARIZONA
Beaver Dam Mountains Wilderness
Beaver Dam
Littlefield
Mesquite
Virgin River
Paiute Wilderness
Mt. Bangs Elev. 8012 ft
Virgin Peak Elev. 8094 ft
LOWER HURRICANE VALLEY
SHIVWITS PLATEAU
UINKARET PLATEAU
GRAND CANYON-PARASHANT NATIONAL MONUMENT
Grand Wash Cliffs Wilderness
Mt. Trumbull Wilderness
Mt. Trumbull Elev. 8029 ft
Mt. Logan Elev 7821 ft
Mt. Logan Wilderness
Bureau of Land Management
SHIVWITS PLATEAU
Parashant Canyon
Whitmore Canyon
Lake Mead National Recreation Area
National Park Service
Lake Mead
Mt. Dellenbaugh Elev. 6471 ft
National Park Service
Sanup Plateau
Hualapai Reservation
Colorado River
Twin Point
Kelly Point
Grand Canyon National Park